THE GENUS THYSANOPODA (CRUSTACEA, EUPHAUSIACEA)

By Keith Sheard

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This difficult genus is characterised as follows: In general as in *Euphausia*, but penultimate pair of legs distinctly developed and of the same structure as the preceding; last pair with the endopod obsolete but having a well-developed exopod. All the true gills provided with an interiorly bent branch, the two posterior pairs rather complex in structure, last pair much the larger and richly arborescent. Flagella of both pairs of antennae greatly elongate. Exognath of second pair of maxillae very small. Luminous globules as in *Euphausia*. Genotype *Thysonapoda tricuspidata* Milne-Edwards 1830.

The main specific characters are to be found in the maxillulae, male copulatory organs, the lappet of the first antennular segment, the presence or absence of lateral denticles on the carapace in the adult, and the presence or absence of teeth or denticles on the midline of posterior margins of the abdominal segments also in the adult.

Thysanopoda should be preserved in 70% alcohol. Formalin, the commonly used preservative not only renders examination difficult but is a source of error in these, as in all crustacean specimens.

The genus is of world oceanic distribution. Australian representatives are: *Thysanopoda obtusifrons* Sars, *T. monacantha* Ortmann, *T. tricuspidata* Milne-Edwards and *T. orientalis* Hansen, and **T. johnstoni** n. sp.

Order **EUPHAUSIACEA**

Family EUPHAUSIIDAE

Genus Thysanopoda Milne-Edwards 1830

Thysanopoda Milne-Edwards 1930, 451; Sars 1885, 97; Hansen 1905, 12; 1905a, 18; 1910, 81; 1911, 1; 1912, 207.

Parathysanopoda Illig 1909, 225.

List of Species and Synonymy

THYSANOPODA TRICUSPIDATA Milne-Edwards 1830

Thysanopoda tricuspide Milne-Edwards 1830, 451, pl. xix; *tricuspida* Milne-Edwards 1837, 45, pl. xxvi, fig. 1-6; *tricuspidata* Sars 1885, 98, pl. xvii; Hansen 1910, 82, pl. xii, fig. 3a-3b; 1912, 208, pl. iv, fig. 2a; 1913, 23; 1916, 637; Tattersall 1913, 873; 1924, 14; 1926, 13; 1936, 165 (larvae); 1939, 212; Zimmer 1914, 416; Illig 1930.

Cyrtopia rostrata Dana 1852.

THYSANOPODA CRISTATA Sars 1883

Thysanopoda cristata Sars 1883, 22; 1885, 104-106, pl. xviii, fig. 15-20; Hansen 1911, 15; 1912, 209-212 (larvae 284-287, pl. xii, fig. 1a-1g), pl. iv, fig. 1a-1b; Zimmer 1914, 416; *biproducta* Ortmann 1893, 8, pl. i, fig. 1.

THYSANOPODA MONACANTHA Ortmann 1893

Thysanopoda monacantha Ortmann 1893, 9, pl. i, fig. 2; Hansen 1912, 212, pl. iv, fig. 3a-3c; 1915, 61; 1916, 638; Zimmer 1914, 417; Tattersall 1926, 14; 1939, 213; Illig 1930, 507, fig.; *agassizi* Ortmann 1894, 99, fig. 1-2; Hansen 1910, 87-89, pl. xiii, fig. 3-g; *lateralis* Hansen 1905, 18-19, fig. 14-19; *ctenophora* Illig 1908, 112-113, fig. 1.

THYSANOPODA AEQUALIS Hansen 1905

Thysanopoda aequalis Hansen 1905a, 18-20; 1910, 84, pl. xii, fig. 4a-4c, pl. xiii, fig. 1a; 1912, 214-215, pl. iv, fig. 4a; 1915, 61-62; 1916 67; Zimmer 1914, 417-418, pl. xxvi, fig. 53-54; Tattersall 1909, 123; 1912, 128; 1924, 15; 1926, 14; 1939, 213; Illig 1930; *obtusifrons* Lo Bianca 1901, 440; Thiele 1905, 452; fig.; Ortmann 1905, 964; *microphthalma* Lo Bianca 1903, 192; *aequalis* var. *latifrons* Colosi 1916, 67.

THYSANOPODA OBTUSIFRONS Sars 1883

Thysanopoda obtusifrons Sars 1883, 21; 1885, 102-104, pl. xviii, fig. 1-14; nec Lo Bianca 1901, 440, and 1903, 192; nec Ortmann 1905, 964; nec Thiele 1905, 452, fig.; Hansen 1910, 15; 1912, 215, pl. iv, fig. 5a-5f; Tattersall 1924, 16; 1939, 213; Zimmer 1914, 419; Chilton 1926, 519; *vulgaris* Hansen 1905, 15; 1905a, 20.

THYSANOPODA PECTINATA Ortmann 1893

Thysanopoda pectinata Ortmann 1893, 10, pl. i, fig. 4; Hansen 1905a, 25; 1912, 218-222, pl. v, fig. 1a-1m; 1915, 62; 1916, 639; Tattersall 1912, 129; 1939, 213; nec Hansen 1905, 20.

Parathysanopoda foliifera Illig 1909, 225; 1930, 510, fig.

THYSANOPODA ACUTIFRONS Holt and Tattersall 1905

Thysanopoda acutifrons Holt and Tattersall 1905, 102, (pars); 1906, 8, pl. i; Tattersall 1925, 6; 1925, 6, pl. ii, fig. 4; 1939, 213; Hansen 1905a, 22; 1910, 85, text fig.; 1912, 218, pl. v, fig. 1a-1m; 1915, 62; Illig 1939; *pectinata* Hansen 1905, 20.

THYSANOPODA ORIENTALIS Hansen 1910

Thysanopoda orientalis Hansen 1910, 222, pl. v, fig. 2a-2c; 1912, 222, pl. v, fig. 2a-2c; 1915, 64-65; 1916, 639; Zimmer 1914, 419; Tattersall 1939, 214; 1936, 166.

THYSANOPODA MICROPHTHALMA Sars 1885

Thysanopoda microphthalma Sars 1885, 106-108, text fig. 3; Hansen 1910, 85, text fig.; Tattersall 1926, 15; nec Lo Bianca, 1905, 192; *distinguenda* Hansen 1905, 17, fig. 13; Holt and Tattersall 1906, 11, pl. ii.

THYSANOPODA CORNUTA Illig 1905

Thysanopoda cornuta Illig 1905, 663-664, fig. 1-3; 1908, 463-464; Hansen 1911, 16; 1912, 223-224; ? 1915, 65-66, 1916, 639; Tattersall 1913, 872; ? 1926, 15-16; 1939, 214 (larvae); Illig 1930, 513; *insignis* Hansen 1905, 19, text fig.

THYSANOPODA EGREGIA Hansen 1905

Thysanopoda egregia Hansen 1905, 22, text fig.; 1912, 225; Illig 1908, 463; ? *megalops* Illig 1908, 54, fig. 1 and 2; 1911, 45-46, fig.

THYSANOPODA MANSUII Marukawa 1928

Thysanopoda mansuii Marukawa 1928, 23.

THYSANOPODA ARMATA Marukawa 1928

Thysanopoda armata Marukawa 1928, 23.

THYSANOPODA SPINULA Macdonald 1929

Thysanopoda spinula Macdonald 1929, 63.

The genus has been divided by Hansen (1912, 206) into two well-marked sections.

GROUP A: Carapace without any distinct cervical groove. Maxillula with the pseudexopod moderately large to very large, at least half its length situated beyond the outer margin of third joint, palp at most moderately long and somewhat over-reaching the third joint. Sixth abdominal segment longer than the fifth.

This section may again be divided.

(1) The carapace in the adult with a denticle on or near the lower margins near their posterior end.

T. tricuspidata Milne-Edwards; *cristata* Sars; *monacantha* Ortmann (= ? *agassizi* Ortmann); *aequalis* Hansen; *obtusifrons* Sars.

(2) Carapace in the adult without denticles on the lower margins near their ends.

T. microphthalma Sars; *pectinata* Ortmann; *orientalis* Hansen; *acutifrons* Holt and Tattersall; *johnstoni* n. sp.

GROUP B: Carapace with a well-developed cervical groove. Maxillula with the pseudexopod somewhat small, scarcely or not at all over-reaching the outer margin of the third joint, palp very long. Sixth abdominal segment shorter than the fifth.

T. cornuta Illig and *T. egregia* Hansen.

I am unable to obtain descriptions of *T. mansuii* and *T. armata* erected by Marakawa 1928, or of *T. spinula* Macdonald 1929.

In Group A, section 1, separation is difficult. *T. tricuspidata* Milne-Edwards possesses two denticles on or near the lower margin of the carapace, and the male of *T. aequalis* Hansen lacks the spine-shaped process (p^1) on the copulatory organs. The remaining three species can be separated by small differences in the copulatory organs and by differences in the frontal plate, antennular lappet and the dorsal armature of the abdomen. The species are good. Careful reference must be made to the appropriate descriptions and figures.

The species of Group A, section 2, may be separated as follows:

Adult males and females—

(a) Antennular lappet multidigitate	*T. pectinata* Ortmann
(aa) „ „ not multidigitate.	
(b) Abdominal segments 4 and 5 slightly acuminate mesially on postero-dorsal margin.	
(c) Antennal scale reaching to end of second segment ..	*T. microphthalma* Sars.
(cc) Antennal scale reaching beyond the end of the second joint	*T. orientalis* Hansen
(bb) Abdominal segments 4 and 5 smooth on the postero-dorsal margin.	
(d) Abdominal side plates 1-2-3-4 slightly indented on the lower margin	*T. acutifrons* H. & T.
(dd) Abdominal side plate 1 not indented, 2-3-4 deeply indented on lower margin	**T. johnstoni** n. sp.

Adult males. Copulatory organs—

(a) Spine-shaped process absent	**T. johnstoni** n. sp.
(aa) Spine-shaped process (p^1) present.	
(b) Terminal process (p^2) saw-toothed behind the terminal margin	*T. microphthalma* Sars.
(bb) Terminal process not toothed.	
(c) Terminal process longer than the proximal process (p^3)	*T. pectinata* Ortmann
(cc) Terminal process shorter than the proximal.	
(d) Terminal process evenly rounded at distal end	*T. orientalis* Hansen
„ „ acutely pointed at distal end	*T. acutifrons* H. & T.

T. aequalis Hansen and **T. johnstoni** n. sp., although in different sections of the genus, are peculiar amongst the *Thysanopoda* in lacking the spine-shaped process of the copulatory organ.

Group B—

(a) Rostral plate slightly up-curved, tip surmounted by a small tubercle .. .. *T. cornuta* Illig.

(aa) Rostral plate down-curved, no rostral tubercle present .. *T. egregia* Hansen

Thysanopoda johnstoni n. sp.

B.A.N.Z.A.R.E. sta. 111 (44° 11′5 S., 143° 36′ E.) N 200, 1,710-0 m., 17 March 1931, surface temperature 12·00°, surface salinity 34·56, 2 ♀ ♀ 39 mm., 1 ♂ 33 mm. "Warreen" sta. 25/38 (37° 14′5 S., 150° 23′ E.) N 70, 500-250 m., 14 August 1938, surface temperature 14·90°, surface salinity 35·50, temperature at 300 m. 11·55°, salinity at 300 m. 35·06, three damaged specimens. Investigator Straits, from stomach of Southern Blue-fin Tuna (*Thunnus maccoyi* Castelnau), one adult.

This species falls into Hansen's group A, section 2, possessing the characteristic maxillula, the sixth abdominal segment longer than the fifth and having neither a cervical groove, nor a denticle on the lower margin of the carapace.

The eyes are small, rounded and brown in spirit specimens, with the produced frontal plate barely protruding beyond them.

The antennule has the first segment the longest, furnished with a lappet similar to that of *T. acutifrons* H. & T. but longer, reaching to the middle of the second segment. The third antennular segment terminates in a small setose lappet.

The antennal squama, fringed with long setae along its curved inner margin and on its slightly curved distal end reaches to a little more than half-way up the third antennular segment. The spiniform outer process from the sub-basal joint is thin and tapering, as long as the breadth of the squama.

In the maxilla the distal segment is ovate, slightly longer than the preceding.

The maxillula resembles that of *T. pectinata* Ortmann but the pseudexopod is narrower and the palp relatively longer. Both the maxilla and maxillula are heavily setose with plumose setae. The abdominal segments are without trace of any denticles dorsally. The side plates of abdominal segments 1 to 5 resemble those of *T. microphthalma*, figured by Holt and Tattersall (1906, pl. ii) as *T. distinguenda*. However the emargination of the lower border of plates 2, 3, and 4 is much greater than for that species.

The preanal spine is well developed and is simple in both male and female.

The endopod and exopod of the uropods are both slightly longer than the telson, which bears four pairs of dorsal denticles.

The copulatory organs are distinctive. The spine-shaped process is absent. The terminal process, about half the length of the proximal, is sickle-shaped at its distal third, but from the bulb of the commencement of the sickle, a flat membrane runs nearly to the tip. At its distal end this membrane bears, on the outer margin, two very small, rounded prolongations.

The proximal process is somewhat of the form figured for *T. orientalis* by Hansen (1912).

The median lobe resembles that of *T. pectinata* figured by Hansen (1912), but the additional process is not hooked, while there are two secondary additional processes. In all the median lobe bears four processes instead of the three normal to the genus.

A subadult female (length, 15 mm.) does not possess a lateral denticle on the carapace.

This species is named in honour of Professor T. Harvey Johnston, Biologist to the B.A.N.Z.A.R.E. and Editor of the Expedition's reports.

Thanks are due to the B.A.N.Z.A.R.E. committee for permission to publish this preliminary description of the species, which will be more fully dealt with in a

forthcoming paper on the Euphausiacea of the Expedition; and also to Dr. H. Thompson of the Division of Fisheries, Council for Scientific and Industrial Research of Australia, for the use of the "Warreen" material.

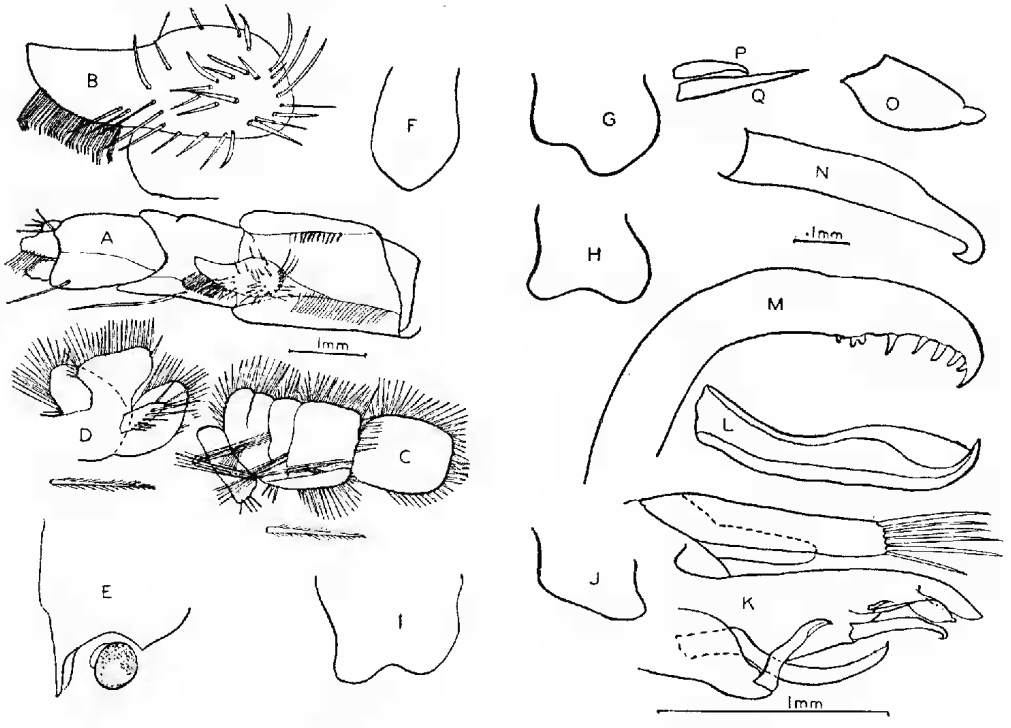

Fig. A-Q **Thysanopoda johnstoni** n. sp.

A, antennular peduncle; B, antennular lappet; C, maxilliped; D, maxillula; E, frontal plate; F-J, abdominal side plates 1-5; K, copulatory organ; L, terminal process (p^2); M, tip of proximal process (p^3); N, lateral process (p^4); O, additional process (p^5); P-Q, secondary additional processes (p^6, p^7).

Thysanopoda Larvae

While no *Thysanopoda* larvae have been definitely correlated with the adults by breeding experiments, it is fairly certain that, by (1) a process of elimination, and (2) comparison of forms gradually approaching an identifiable stage, the larvae of several species have been identified.

The larvae of *T. acutifrons* have been recorded by Frost (Proc. Roy. Irish Acad., 45, B, No. 13) and of *T. tricuspidata* by Sars (1885) and Tattersall (1936). Other larvae belonging to the genus, if not to the ascribed species, are:

T. agassizi Hansen 1910; *T. orientalis* of Hansen 1910; *T. aequalis, obtusifrons* and *pectinata* of Hansen 1912.

There appears little possibility of working out any scheme whereby conclusive specific identifications of single stages of Euphausiid larvae can be made, although generic separations are possible following on a working knowledge of the group. It is extremely difficult to reduce this knowledge to exact definition. Keys based on the emergence of pleopods are unsound guides. For example, the examination of plankton secured by the "Warreen" over a period of four years along the Southern and Eastern coastline of Australia shows enormous numbers of larvae which can certainly be referred to the genus *Nyctiphanes* and which present, over all, every form of pleopod emergence with no one form dominant over the whole area, although at certain times in certain areas one form or the other may be statistically dominant.

It is extremely likely that particular minor phases of development which may be passed through are as much expressions of the available food supply as of anything else.

Opinions on the significance of minor developmental stages in the Euphausiid larvae have changed from the purely schematic (Lebour 1926, Jour. Mar. Biol. Assoc., U.K., N.S., 14) to a consideration of dominant stages (Fraser 1936, Discovery Reports 14). A wider view has been taken by Rustad (Norske Vidensk. Ak., Oslo, 1930, 1 (5)) who, as the result of work done by the Norwegian Antarctic Expedition of 1927-1928 et seq., endeavours to consider the organism as a whole and discards the idea of a schematised development beyond the very early stages.

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